Center for Dark Energy Biosphere Investigations (C-DEBI)

NSF Directors meeting
Aug. 31 - Sept. 1 2010

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UNIVERSITY OF ALASKA FAIRBANKS · UC SANTA CRUZ · UNIVERSITY of HAWAI'I MĀNOA · THE UNIVERSITY OF RHODE ISLAND · UNIVERSITY OF SOUTHERN CALIFORNIA

C-DEBI

A center for resolving the extent, function, dynamics and implications of the Subseafloor Biosphere

Explore life beneath the seafloor and make transformative discoveries that advance science, benefit society, and inspire people of all ages and origins

Motivations

History

Goals

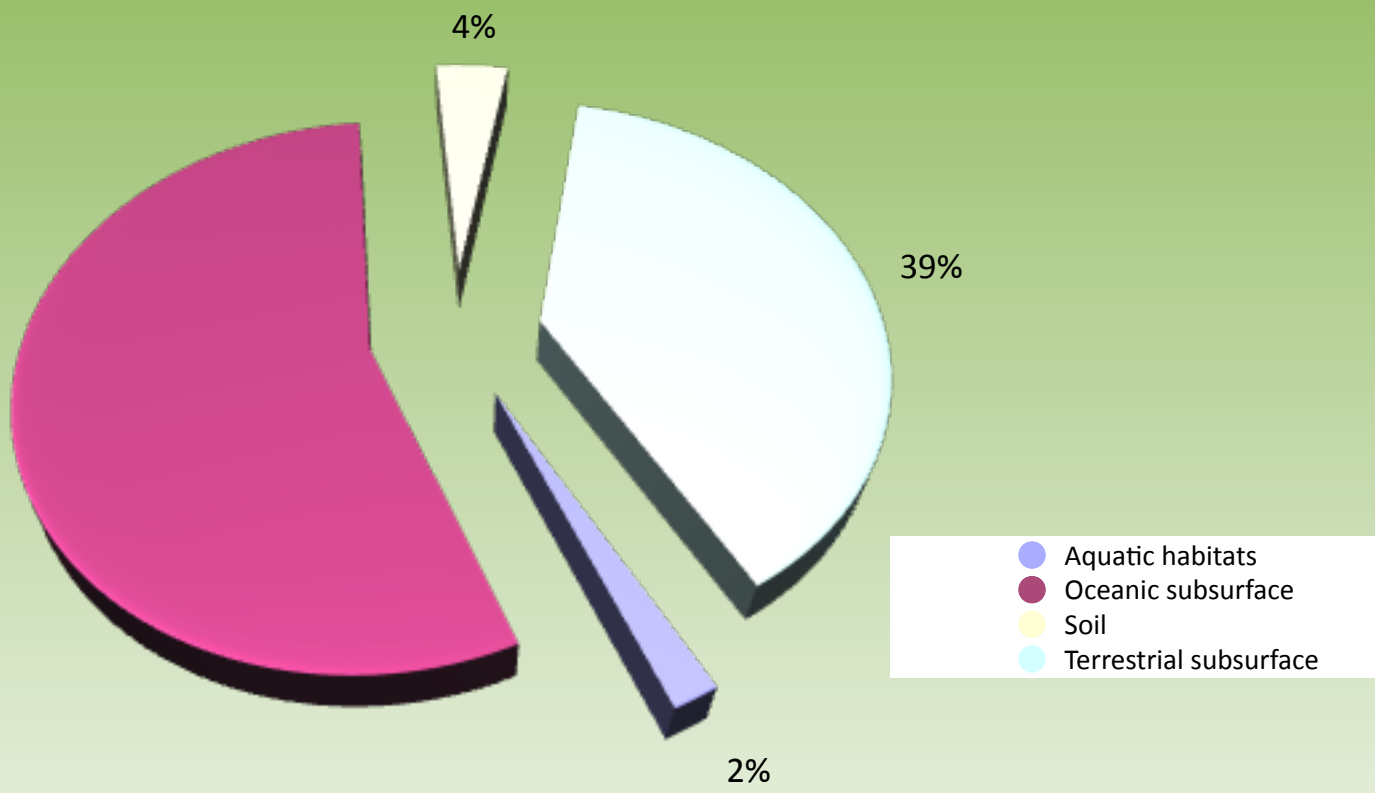
An internationally coordinated distributed center

DEBI Research Coordination Network

*A Global Census Reveals a Hidden Majority: the **Intraterrestrials***

Number of prokaryotic cells, x10^{28} (bacteria + archaea)

~1/3 of Earths biomass carbon



Whitman *et al.,* PNAS 1998

A Hidden Majority?

Are they **alive**?

Who is there?

What are they **doing**?

Consequence for the Earth system?

Does their influence scale to these vast numbers and habitat size?

Carbon, nitrogen, iron, sulfur global biogeochemical cycles etc.

Subseafloor Microbes Matter

Example of planetary consequences:
Subseafloor methane production

- ***Methane produced by subseafloor microbes has and will influence Earth's climate***
- ***Constitutes the largest untapped fossil fuel reservoir on Earth***

Historical Perspective

- IODP: Integrated Ocean Drilling Program: 2003-2013
- ODP: Ocean Drilling Program: 1983-2003
- DSDP: Deep-sea Drilling Project: 1966-1983

WHY C-DEBI?

Explore life beneath the seafloor and make transformative discoveries that advance science, benefit society, and inspire people of all ages and origins

→ ***TWO DECADES*** of field, laboratory, theoretical research in labs around the world

→ ***ONE*** major microbiology field project (ODP leg 201) drilled to date

→ ***THREE*** IODP microbiology field projects are scheduled with US leads (2010-2011)

WHY C-DEBI?

Explore life beneath the seafloor and make transformative discoveries that advance science, benefit society, and inspire people of all ages and origins

→ ***Capitalize*** on opportunity

→ ***Maximize*** scientific return

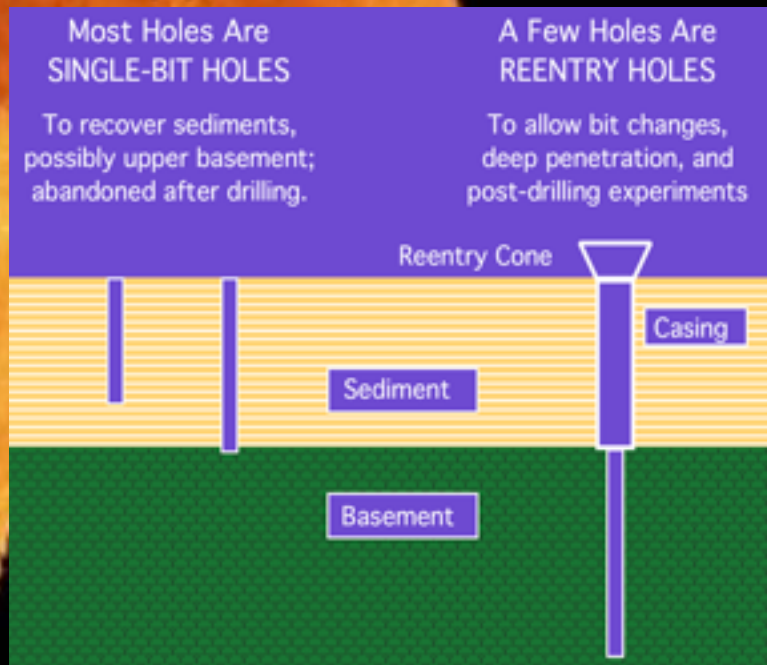
→ ***Bundle, integrate, extend***

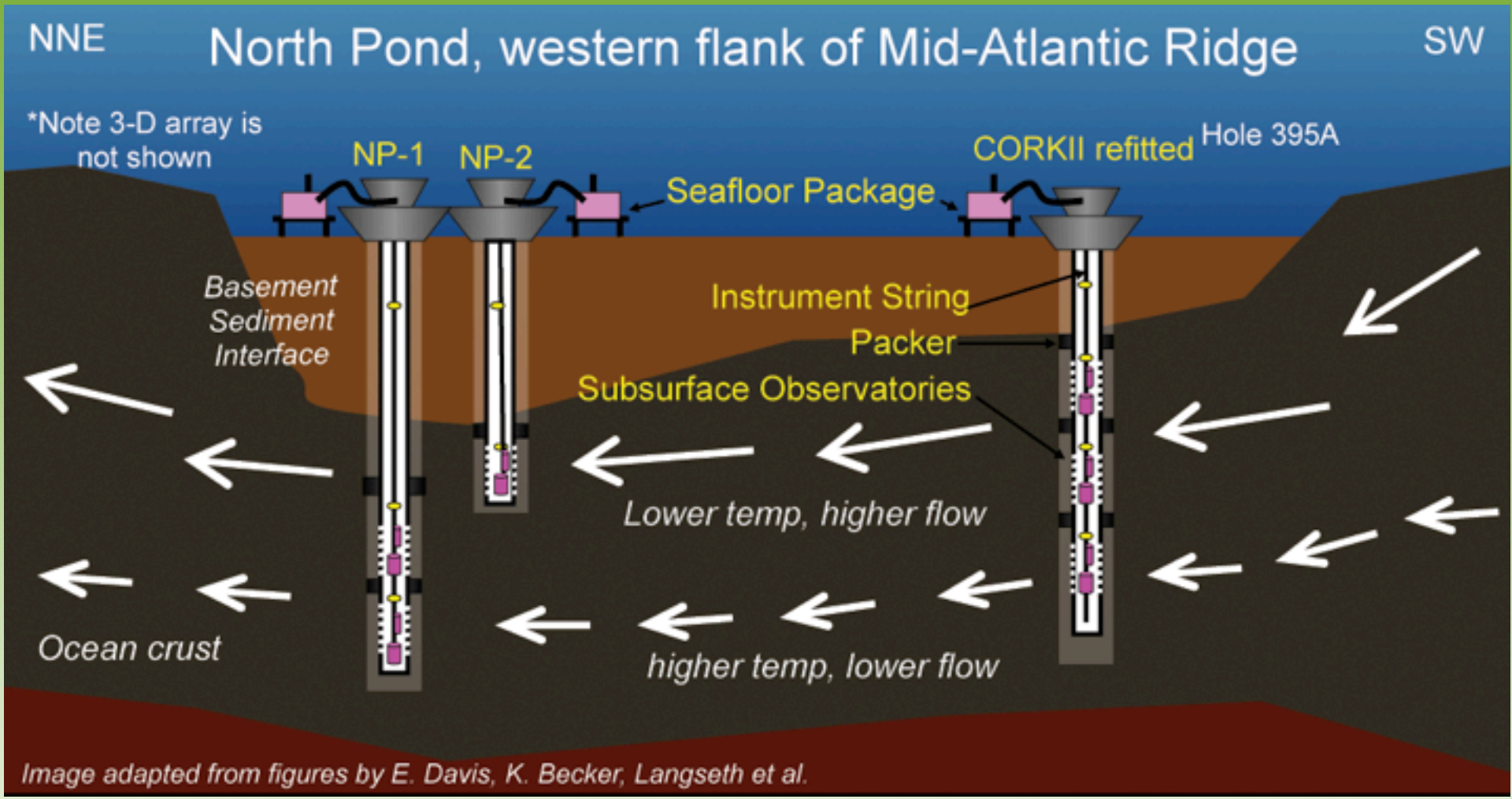
→ ***Educate, outreach:*** *build the future*

C-DEBI Technology, Engineering: Tools for the "missions" to our "moon"

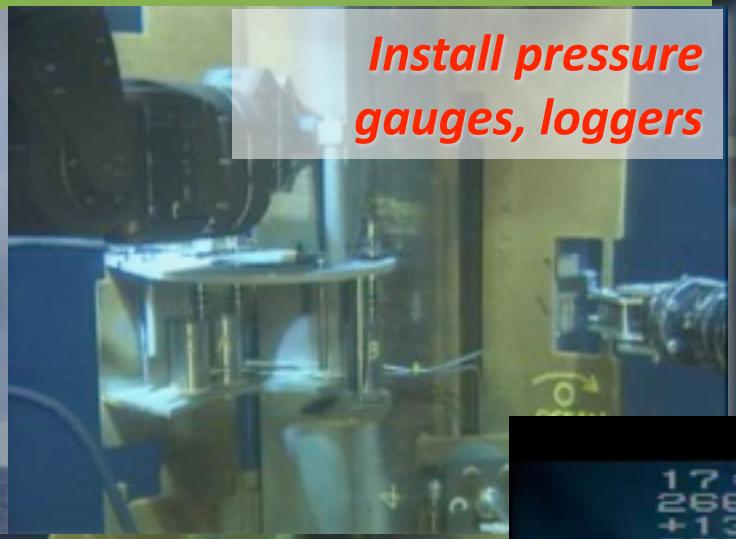
CORK Bodies, Casing Hangers

Types of Drill Holes



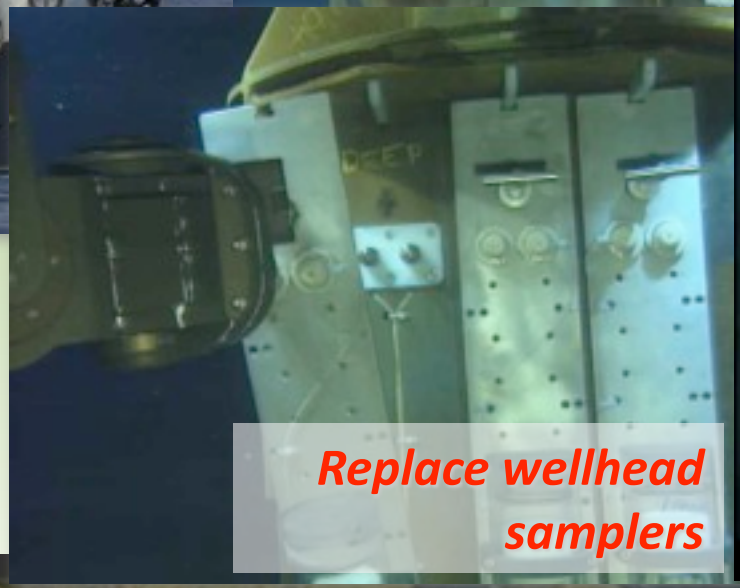

NNE
North Pond, western flank of Mid-Atlantic Ridge
SW
*Note 3-D array is not shown
NP-1
NP-2
CORKII refitted
Hole 395A
Seafloor Package
Basement
Sediment
Interface
Instrument String
Packer
Subsurface Observatories
Lower temp, higher flow
Ocean crust
higher temp, lower flow
Image adapted from figures by E. Davis, K. Becker, Langseth et al.

CORK Servicing: multi-decade experiments



Install pressure gauges, loggers

Manipulate valves



Replace wellhead samplers

Greetings from Expedition 327! Juan de Fuca Ridge Flank Hydrogeology

adopt a microbe info at:
sites.google.com/site/adoptamicrobe/
darkenergybiosphere.org

C-DEBI

Center for Dark Ene

STC Directors Meeting, Nat

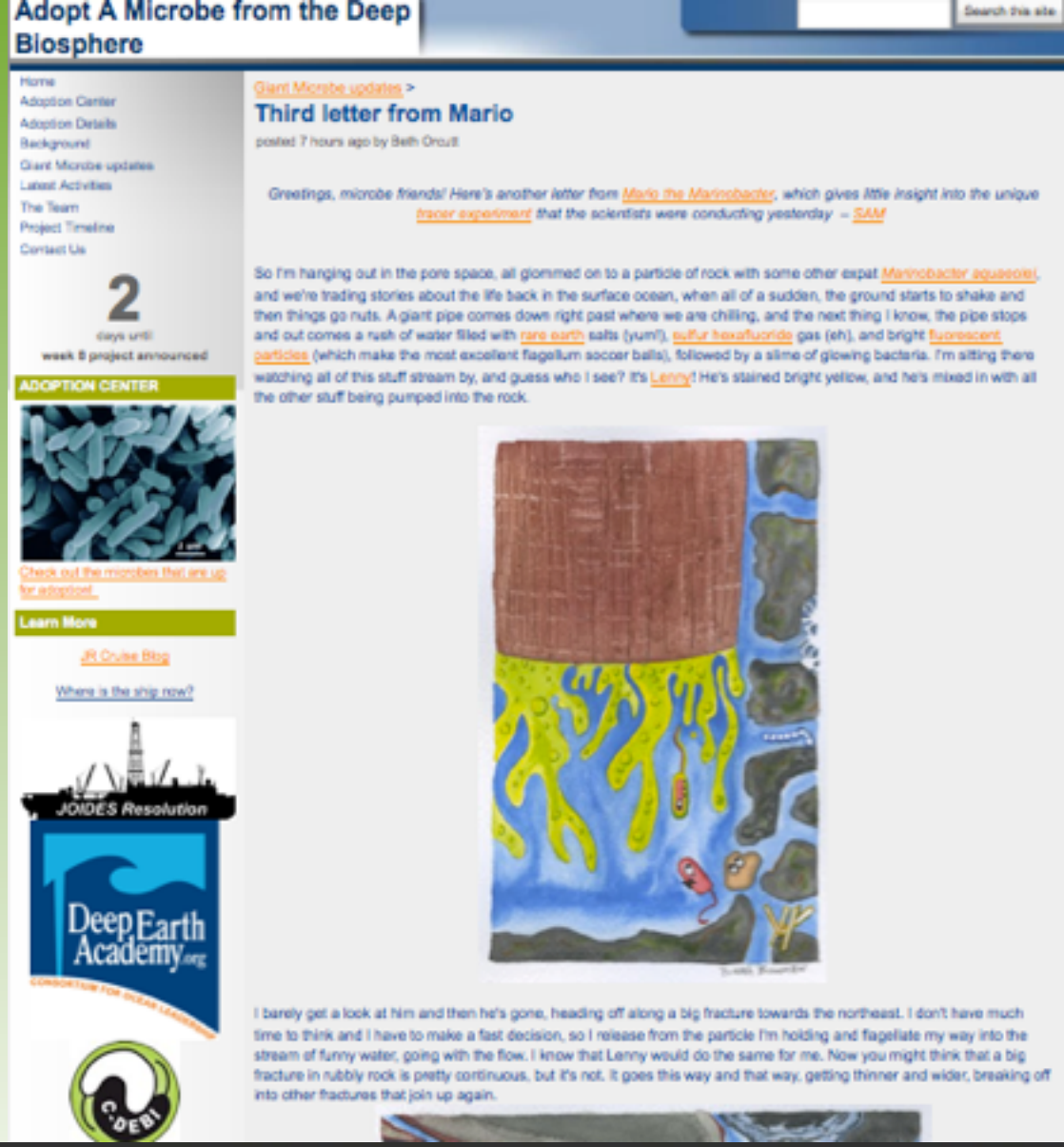
Education, Outreach & Diversity

- Broad range of programs K-grey

- Focus on our sea-going and technology (e.g., robotics) strengths

- Have FUN with our programs (i.e., adopt a microbe)

-PROMOTE to general public the coolness factor of what we do



One Example: GEM

- Summer Minority Program in Microbiology
- 3 weeks on USC campus, 3 weeks on Catalina Island
- Hands-on experience opportunities in the field, lab in environmental micro
- Guidance on career tracks in science, policy, and more

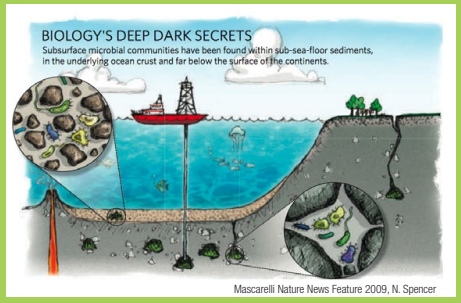
Center for Dark Energy Biosphere Investigations

Resolving the extent, function, dynamics and implications of the subseafloor biosphere

Global Environmental Microbiology (GEM)

Underrepresented Minority Summer Course 2011


Pele's Pit trap, FEMO 2007



Mascarelli Nature News Feature 2009, N. Spencer

Studying Microbes is Fun…Seriously!

Microbes are the beginning and end for almost every process on earth! From hydrothermal vents at the bottom of the ocean, to tropical rainforests near the equator, and from the North to South Pole, microbiologists uncover their secrets.

Don't you want to come exploring? You don't have to travel that far—only off the coast of California to Catalina Island. In partnership with the National Science Foundation, the Center for Dark Energy Biosphere Investigations (C DEBI) will offer a course in microbiology and microbial ecology. Taught by Drs. Eric Webb and John Heidelberg this field-based, hands-on course will be:

- Offered at the University of Southern California
- Four weeks in length in the Summer of 2011
- Weeks 1 and 2 at USC with lectures and lab
- Weeks 3 and 4 at the Wrigley Marine Science Center on Santa Catalina Island
- Field trips to La Brea tar pits, mountains, sewage plants and Long Beach Aquariums

So come and get your "feet wet" in microbial ecology and learn what bacteria are, how they work, and what they do. Explore DNA, genetics and genomics and their potential function in the environment. Figure out how microbes are used—not just for wine and cheese.

Course Contacts: John Heidelberg • jheidelb@usc.edu; 310-510-4040
Eric Webb • eawebb@usc.edu; 213-740-7954
For additional course information please visit the Dark Energy Biosphere website:
http://darkenergybiosphere.org

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Dark Energy Ecosystems

Ecosystems that exist in the dark - one or more steps removed from photosynthesis that drives the surface world…

➡ In physical cosmology - dark energy and dark matter account for the majority "missing matter" in the universe

➡ On planet Earth, life buried beneath its surface may account for the majority of biomass carbon